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“THE EQUATION OF EXCHANGE,” 1896-1910.

In my book on *The Purchasing Power of Money*¹ I have endeavored to express in figures and diagrams the rise of prices in the United States and the causes of this rise for the period 1896-1909. When the book was about to go to press sufficient data were received to make it possible to include in an addendum the corresponding figures for 1910, but it was, of course, not possible to make the corresponding changes in the diagrams.

The object of the present paper is chiefly to reconstruct the principal diagram (figure 14) so as to include 1910. I shall take this opportunity to include also a correction for the year 1900 called to my attention through the kindness of Professor O. M. W. Sprague,—a correction which increases the figure for M' , deposits subject to check, from 4.24 to 4.44 and decreases the figure for V' , their velocity of circulation, from 40.1 to 38.3.

According to the theory of Ricardo, as algebraically expressed by Newcomb, Hadley and Kemmerer, and elaborated in *The Purchasing Power of Money*, the general level of prices (P) in any community is determined by five and only five factors; namely, M , the volume of money in circulation; V , the velocity of its circulation, (that is, the number of times that the money in circulation is “turned over” in a year, or what is sometimes called “the efficiency of money”); M' , the volume of bank deposits subject to check; V' , their velocity of circulation, (that is, the number of times they turn over in a year, or what bankers sometimes call the “activity” of bank accounts); and T , the volume of trade, or the transactions effected by money and deposits. These five determining magnitudes and the sixth magnitude, P , determined by them, are connected by the “equation of exchange”, namely $MV + M'V' = PT$.

In this equation, MV , the product found by multiplying the money in circulation by its velocity of circulation, expresses the total monetary circulation or the total expenditure of money per annum; and $M'V'$, the product found by multiplying the deposits subject to check by their velocity of circulation, expresses the total deposit circulation or the total expenditure by check per annum. Consequently the sum $MV + M'V'$, constituting the left side of the equation, represents the grand total expenditure in a year by both money and checks. The right side of the equation rep-

¹The Macmillan Company, 1911.

resents the total value of the goods bought expressed as the product found by multiplying the price level by the volume of trade. The price level (P) is the index number of general prices for the year under consideration, e. g. 1910, relatively to 1909 taken as the base year; and the volume of trade (T) is the value of the trade in the year under consideration, e. g. 1910, reckoned at the prices, not of that year, but of the base year, 1909.²

Thus the equation of exchange merely expresses in form convenient for analysis the fact that the currency paid for goods is the equivalent of the value of the goods bought.

In Chapter VIII of my book I have endeavored to show that in the equation of exchange, P is in general the passive element or puppet of the other five factors which stand to it in the relation of cause to effect.³

From the equation of exchange we may evidently express the price level (P) in terms of the five factors which determine it, as follows:

$$P = \frac{MV + M'V}{T}$$

In *The Purchasing Power of Money* statistical calculations were made for all five of the price-determining magnitudes; and from these calculated magnitudes the resultant value of P was derived. This value of P , as thus indirectly derived, was then compared with its actual value as directly calculated by index numbers. The discrepancies between the results of the direct and indirect methods of obtaining P imply statistical errors in the various calculations but these discrepancies proved to be remarkably small. In order to eliminate these small discrepancies thus found, slight revisions were next made in each of the six magnitudes in the equation of exchange. In other words, each of the six magnitudes, as inde-

² T may be conveniently regarded as the total *number of units* of goods exchanged when the units are expressed not in terms of tons, pounds, etc., in which they are usually expressed commercially, but in terms of specially constructed units, the unit for each commodity being the amount of that commodity which was worth one dollar in the base year (1909). Likewise P may conveniently be regarded as the average price per unit at which these goods are sold, these prices being stated, not in terms of tons, pounds, etc., but in terms of specially constructed units—namely, the “dollar’s worth” for each good in the base year (1909).

³ The cases in which (as during transition periods) this proposition is not strictly true are fully discussed in the book, but need not concern us here.

pendently calculated, was frankly altered in order to make all six exactly fit into the equation of exchange as the true figures necessarily must. The alterations thus necessary were extremely small, seldom exceeding 1 per cent; in more than six sevenths of the cases not exceeding 2 per cent; and reaching at the very utmost only 5 per cent. The final figures are as follows:⁴

⁴I shall not attempt here to explain in detail how these various magnitudes were calculated, as all details are given in *The Purchasing Power of Money*. For present purposes the following brief descriptions will suffice: M, the money in circulation, is taken from the estimates of the Director of the Mint and the Comptroller of the Currency, corrections being made for the errors now believed to have been committed in the earlier estimates for gold in circulation. By money in circulation is meant money standing ready for commercial purchases. It therefore excludes money in the United States Treasury and in banks. M' is based on the reports of the Comptroller of the Currency for individual deposits, after adding the estimated unreported deposits and after deduction of all deposits in savings banks and exchanges for clearing houses, and estimated deposits not subject to check,—this last on the basis of calculations by the Monetary Commission for 1909, repeated at my request for 1896, 1899 and 1906. The velocity (V) of circulation of money was worked out by the method explained by me in the *Journal of the Royal Statistical Society* for December, 1909. ("A Practical Method of Estimating the Velocity of Circulation of Money"). The velocity (V') of circulation of bank deposits was worked out by an analogous method. T, the volume of trade, was based on the statistics of internal commerce as published by the Bureau of Statistics in the Department of Commerce and Labor and includes also statistics of quantities of commodities exported and imported, sales of stocks, railroad tons carried, and postoffice letters carried. P, the price level, was based principally on the figures of the Bureau of Labor for the wholesale prices of two hundred and fifty-eight commodities, but partly also on prices of stocks and wages per hour.

FINALLY ADJUSTED VALUES OF ELEMENTS OF EQUATION OF EXCHANGE.

	M	M'	V	V'	P	T
1896.....	.88	2.71	18.8	36.6	60.3	191
1897.....	.90	2.86	19.9	39.4	60.4	215
1898.....	.97	3.22	20.2	40.6	63.2	237
1899.....	1.03	3.88	21.5	42.0	71.6	259
1900.....	1.18	4.44	20.4	38.3	76.5	253
1901.....	1.22	5.13	21.8	40.6	80.5	291
1902.....	1.25	5.40	21.6	40.5	85.7	287
1903.....	1.39	5.73	20.9	39.7	82.6	310
1904.....	1.36	5.77	20.4	39.6	82.6	310
1905.....	1.45	6.54	21.6	42.7	87.7	355
1906.....	1.58	6.81	21.5	46.3	93.2	375
1907.....	1.63	7.13	21.3	45.3	93.2	384
1908.....	1.62	6.57	19.7	44.8	90.3	361
1909.....	1.61	6.68	21.1	52.8	100.0	387
1910.....	1.64	7.23	21.0	52.7	104.0	399

The year 1909, taken as the base year, was the end of the period first under examination, 1896-1909, and affords a beginning for a new series for subsequent years.

There are various methods of representing visually the changes in each of the six magnitudes just given, but most of these methods fail to show the relations mutually existing between these magnitudes. The method of representation here employed is that given in *The Purchasing Power of Money*. It is based on the analogy between the equation of exchange and the mechanical balance or steelyard; for, in a sense, the expenditures of money and checks exactly balance the value of the goods bought.

The left and the right side of the balance symbolize respectively the left and the right side of the equation of exchange. The smaller weight at the left, symbolized by a purse, represents the money (M) in circulation in the United States. The larger weight at the left, symbolized by a bank book, represents the deposits (M') subject to check. The distance to the left of the fulcrum at which the first weight (purse) is hung represents the efficiency of this money or its velocity (V) of circulation, and in like manner the distance to the left at which the bank book is hung represents the velocity (V') of circulation of bank deposits subject to check. The volume of trade (T) is represented by a tray hanging on the right side and containing a miscellaneous assortment of goods symbolizing the total mass of goods exchanged in a year. The general average of prices (P) at which these goods are sold is represented by the distance to the right of the fulcrum at which the tray hangs. The equality between the two sets of magnitudes is symbolized by the equality or balance between the strains on the two sides of the fulcrum. Each weight exerts on its side a strain measured by the product found by multiplying that weight by its leverage or distance from the fulcrum. Thus, on the left, the purse exerts a strain measured by the product found by multiplying its weight (M) by its leverage (V); and the bank book exerts a strain measured by the product found by multiplying its weight (M') by its leverage (V'); so that the total strain on the left is measured by $MV + M'V'$. This total strain is exactly balanced by the equal and opposite strain of the tray on the right—a strain measured by the product found by multiplying its weight (T) by its leverage (P).

Thus the equilibrium of the balance symbolizes clearly the equation

$$MV + M'V' = PT.$$

An increase in the weights or leverages on one side requires, in order to preserve equilibrium, a proportional increase in the weights or leverages on the other side. If, now, the velocities of circulation (left leverages) remain the same, and if the volume of trade (tray at the right) remains the same, then any increase in the nation's purse or bank account (left weights) will require a lengthening of the leverage at the right, representing prices.

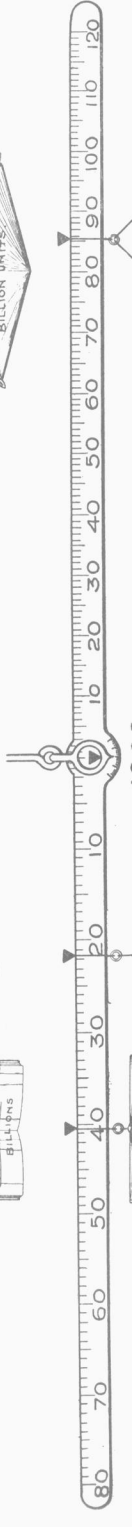
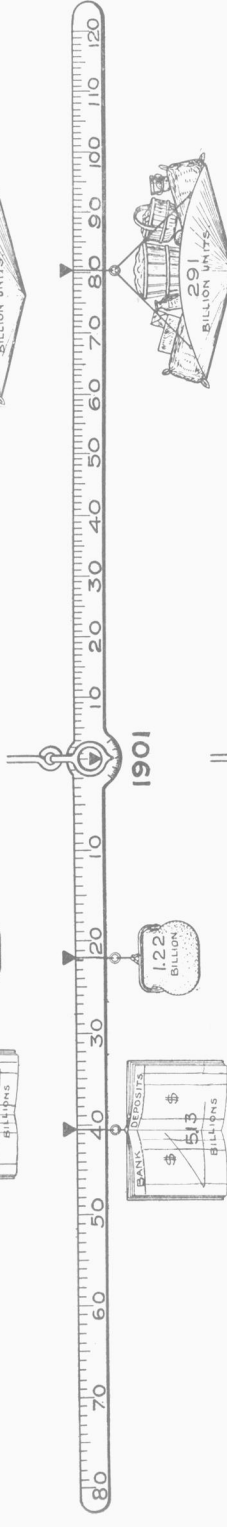
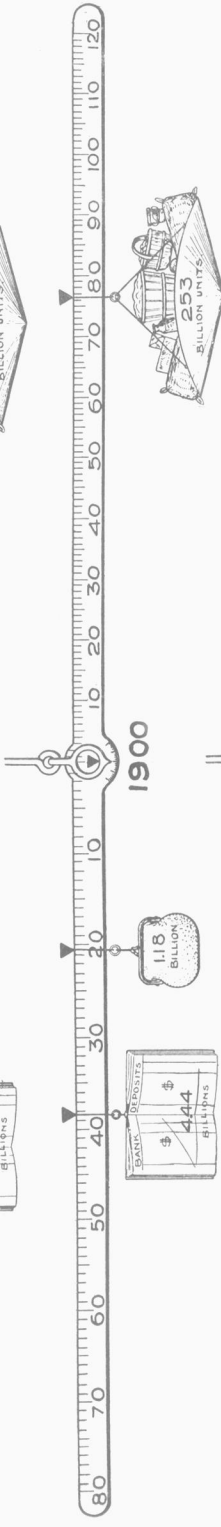
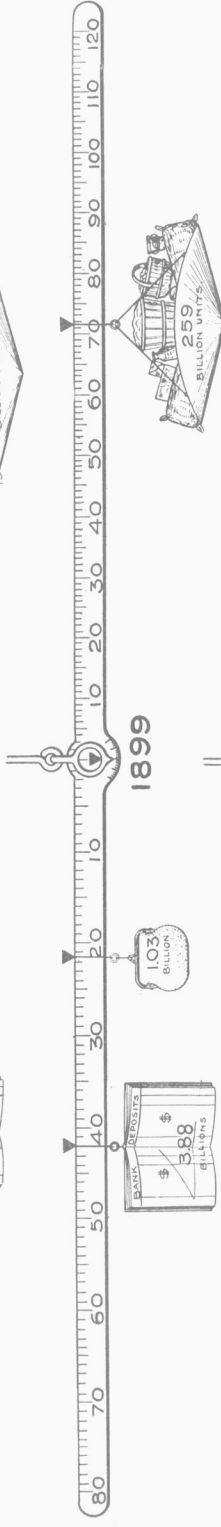
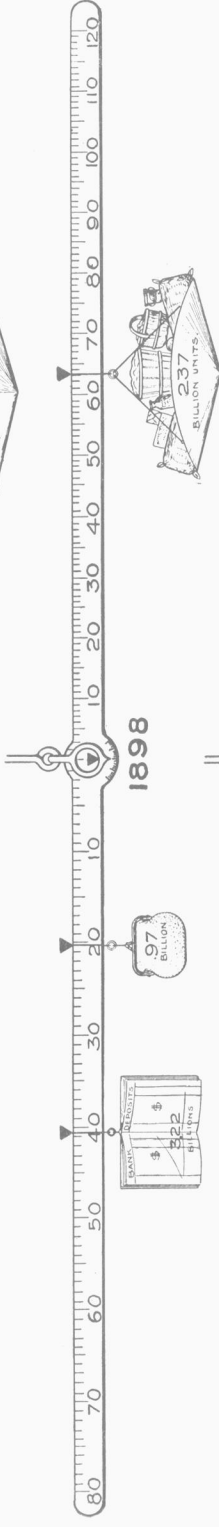
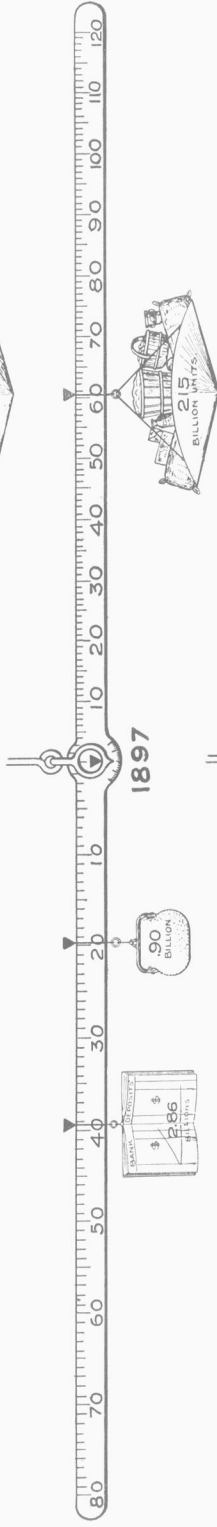
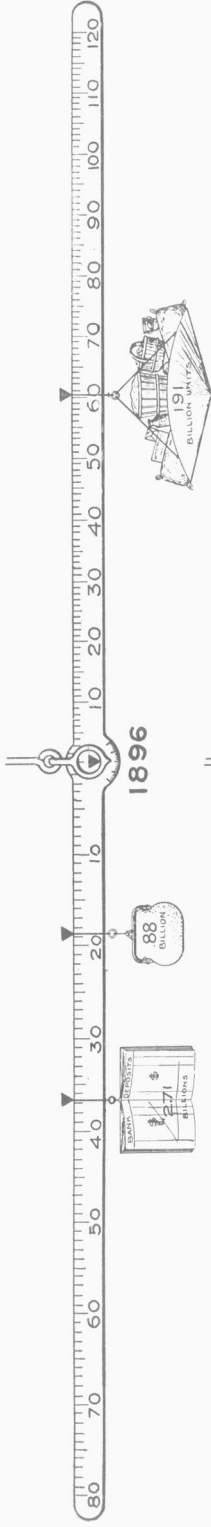
In the figure this symbolism is repeated for each of the fifteen years for which the magnitudes involved have been calculated, and it is easy to trace with the eye the changes in the various magnitudes both singly and in their mutual relations.

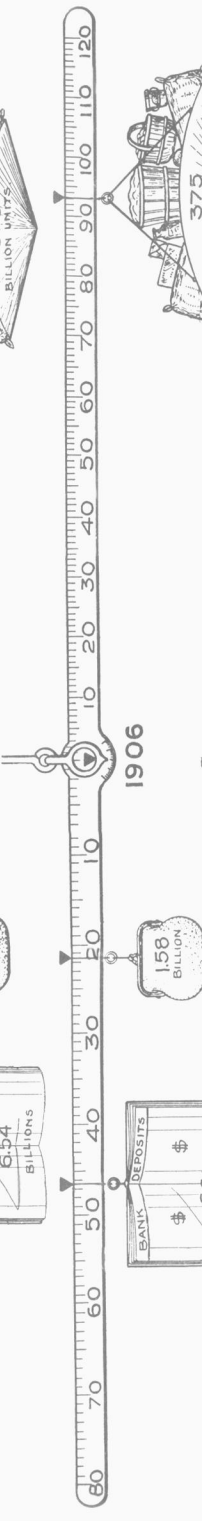
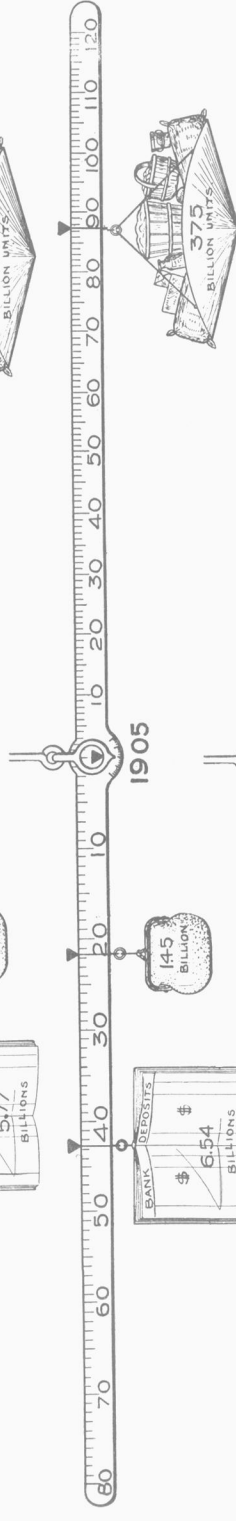
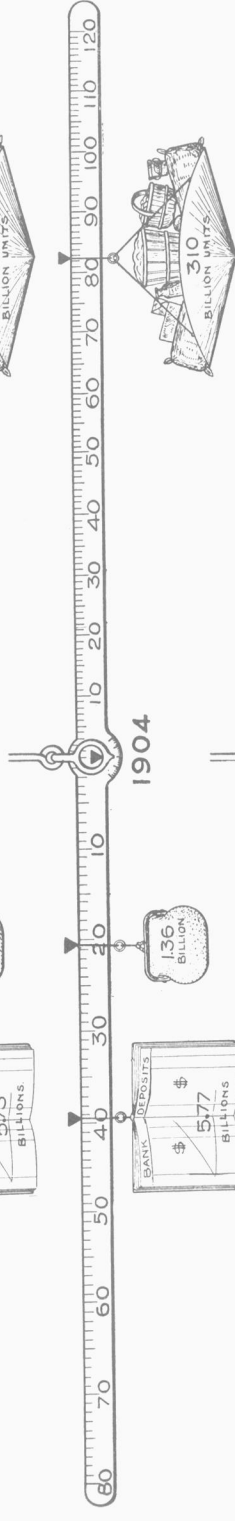
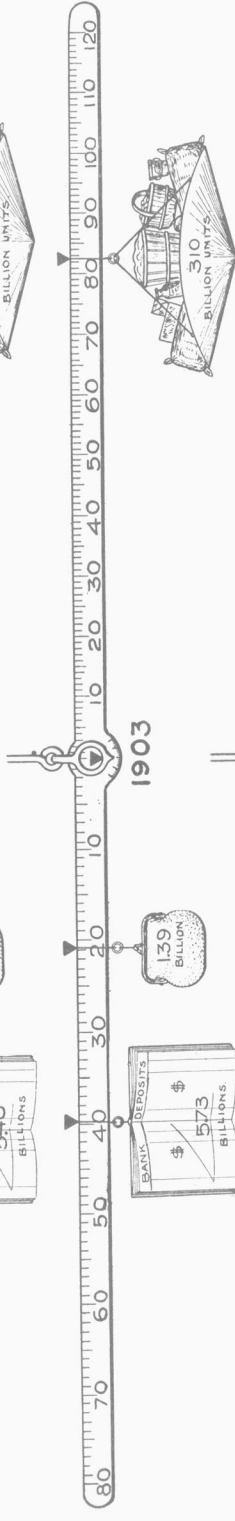
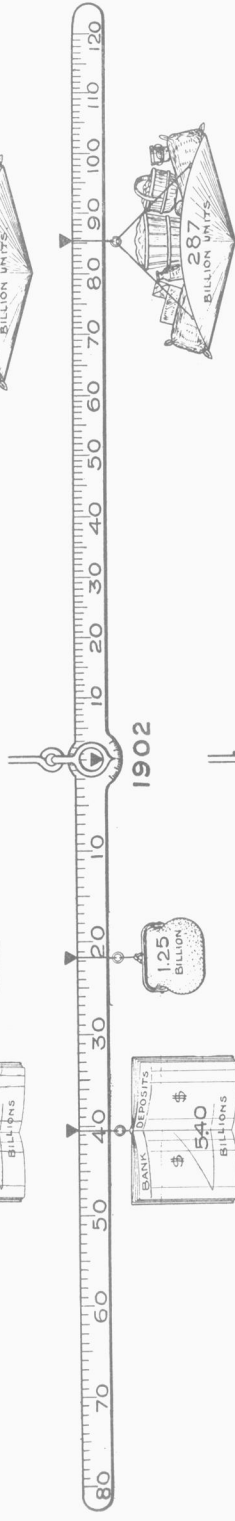
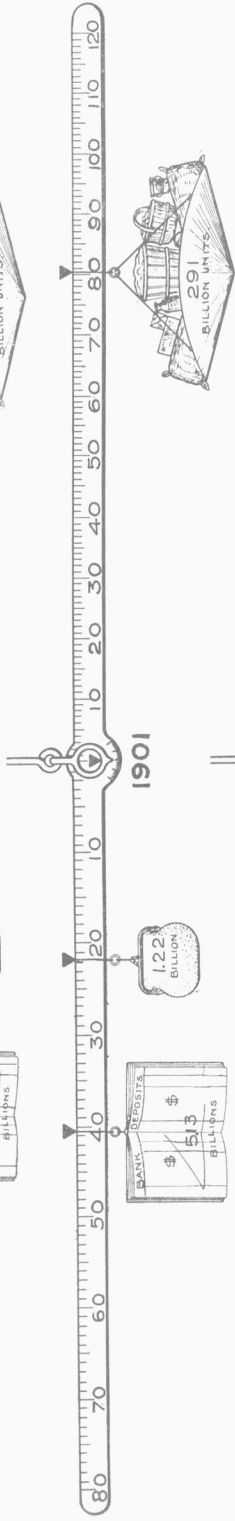
We may in general summarize what has happened by stating that there has been a general *expansion*, that is, an increase of the hanging weights and a movement of them away from the center. The only exception to this general expansive movement worth mentioning was in the year 1908 following the crisis of 1907.

We observe that the nation's purse (M) grew steadily, approximately doubling in the fourteen years between 1896 and 1910, and that its velocity of circulation (V) changed but slightly; that the nation's bank-book (M') grew more rapidly, approximately tripling in the fourteen years; and that the velocity of the deposit circulation (V') or activity of bank accounts also increased rapidly and especially during the last few years; that the volume of trade (T), symbolized by the tray, doubled while general prices increased by three quarters.

The most noteworthy year represented is the crisis year, 1907, in which deposits reached a maximum,—their velocity of circulation having reached a maximum in the previous year. The last two years, 1909 and 1910, are also noteworthy because in those years the velocity of circulation of bank deposits has been unprecedentedly high. This high velocity means that the average man in the United States is now keeping an extremely small bank balance relatively to the large expenditures he is making; that is, he is leaning toward a spendthrift policy. This fact is especially interesting in view of the observation of Pierre des Essars that the activity of bank accounts in the continental banks of Europe increases rapidly prior to a crisis, usually reaching a maximum in the crisis year.

If we seek to explain the relative effect on prices of the changes in the five factors, we note that the changes in only four of them (the left factors M, M', V, V') have tended to produce a rise. The

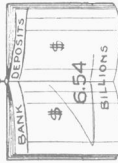




1904



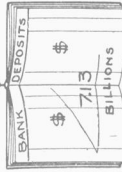
1905



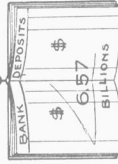
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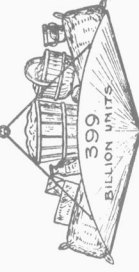
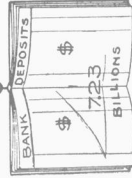
1908



1909



1910



change in the fifth, the increase in the volume of trade, has tended to produce a fall. Of the four price-raising causes we find the most important *absolutely* to be the increase in bank deposits (M'). But if we measure these bank deposits (as they should be measured) *relatively* to the money in circulation, then their increase is found to be a less important price-raiser than the increase in the quantity of money. Fully as important as the increase of deposits is the increase in their velocity, V' . The least important price-raising factor is V , the velocity of circulation of money.

The relative importance of the four price-raising factors can be stated numerically if we compute from the equation of exchange what the rise of prices between 1896 and 1910 *would have been* had any particular one of the four price-raising factors, instead of increasing, remained unchanged, assuming of course that the other three factors and the volume of trade should have changed exactly as they did change.⁵ We find that had it not been for the increase of M from .88 to 1.64, that is, if M had remained .88 throughout the period under consideration while the other factors had changed exactly as the facts show that they did, (namely, $\frac{M'}{M}$ from 3.1 to 4.4; V from 18.8 to 21; V' from 36.6 to 52.7; T from 191 to 399), prices, instead of changing from 60.3 to 104.0, would have changed from 60.3 to about 56. In other words, prices, instead of rising as they did rise 72 per cent would have actually *fallen* 7 per cent. By similar calculations we find that had it not been for the relative increase in bank deposits, that is, for the increase of $\frac{M'}{M}$, prices, instead of rising 72 per cent, would have risen only 25 per cent. Again, had it not been for the increase in V , prices, instead of rising 72 per cent, would have risen only 71 per cent, and had it not been for the increase in V' , prices instead of rising 72 per cent would have risen only 24 per cent.

⁵ Such a calculation is easily made by taking the formula $P = \frac{MV + M'V'}{T}$

or, transformed for our present purposes, $P = \frac{MV + \left[\frac{M'}{M}\right]M'V'}{T}$, and substituting on the right hand side the statistical value for 1910 for T and for *all but one* of the four price-raising factors, $M, \frac{M'}{M}, V, V'$, their statistical values for 1910, and for the remaining one the statistical value for 1896.

Putting the matter in a slightly different way we may say that had it not been for the increase in money in circulation (M), prices for 1910 would have been 46 per cent lower than they were, while with similar calculations for $\frac{M'}{M}$, V' and V respectively the prices would have been lower by 28, 28 and 1 per cent. In other words of the four price-raising causes namely the increases in M , $\frac{M'}{M}$, V and V' , the increase in money (M) is by far the most important and the increase in its velocity (V), by far the least important, while the other two—relative deposits $\left[\frac{M'}{M}\right]$ and their velocity (V')—stand approximately half-way between.

It need scarcely be noted that although these five factors fully account for all changes in the price level, yet other influences exist anterior to these factors. The proper mode of conceiving these other influences is to regard them as influencing prices, not directly, but indirectly by influencing one or more of the five factors (M , M' , V , V' , and T) on which, and on which alone, the price level (P) directly depends. Of these anterior or indirect influences on the price level the most important seem to be: first, the increase in the world's gold production, to which is chiefly due the increase in M noted; second, the concentration of population in cities, which has increased V' ; third, the increase in banking facilities which has increased M' . Doubtless numerous other factors exist less important than the three mentioned. Gold is believed to be by far the most important factor. The changes in tariff laws have probably exerted some influence but that influence seems to be slight.⁶

It is noteworthy that in the year 1910 there has been little increase of money in circulation as compared with the previous year, and that the increase of prices during that year is almost solely due to the increase of bank deposits.

We cannot, however, infer that gold production played no part in the prices for 1910 as compared with 1909. The problem of price levels is an international one, and had it not been for the especially American fact of the increase of bank deposits, this country doubtless would have shared in the world's increased stock of money. The increase of deposits has tended to prevent what would have been the natural increase of money in the United

⁶ See *Purchasing Power of Money*, pp. 312-314.

States. Putting the matter in a different light, we may say that if there had been no increase in the money of the world as a whole but only an increase in American deposits and if there had occurred the same increase in American deposits (relatively to money) there would have been an actual decrease in the money in the United States for the deposits would have expelled the money. Such expulsion was only prevented by the increase of money abroad. Consequently, while money in the United States is not very much greater than it was a few years ago, it is very considerably greater than it *would have been* had it not been for the increase of the world's money resulting from the increased production of gold. Had our currency been subjected to both inflations—that of money (M) and that of deposits (M')—our prices would have risen disproportionately to foreign prices. It was, in fact, a tendency toward such a disproportionate rise in American prices that prevented the increase of our stock of money, for it made America a good country to sell in and a poor country to buy in, thus affecting the foreign exchanges.

What is the outlook for the future? Prediction is hazardous at all times, and especially now, as the present tendencies are not altogether simple and self-consistent and there exist currents and cross currents. Thus the sales of stocks and our exports and imports have declined during 1910 as compared with 1909, while our internal commerce has expanded. Again the prices of stocks have decreased while the prices of commodities have increased. Furthermore, the clearings, which are an indication of the payments by check ($M'V'$) have decreased in New York City while outside of New York City they have increased.

At the present writing the best indications seems to point to the conclusion that the year 1911 will show a general contraction; that is, a shrinkage of the weights in our mechanical balance (especially M') and their movement toward the fulcrum—and this without a disturbance sufficiently acute to be called a crisis. However, it seems also probable, in view of all the circumstances⁷ of the case, and especially of the progressive increase in the gold supply, that

⁷ These include an inflation of land values, of bank loans and deposits based on these land values, and of the rates of interest on farm loans, an increased "slowness in collections" observed by credit men, continued great bank clearings outside of N. Y. City, increased failures and increased investments, as well as, on the other hand, slight falling off in building, in bank clearings in N. Y. City, in immigration, and in commodity prices.

the upward trend of prices and the tendency toward expansion of trade, and of money and deposits with their velocities, will be resumed within a year or two, continuing until the process does culminate in a crisis. In other words, in spite of the apparently impending recession, we are still in a period of incubation for a future crisis. The exact date of such a crisis, of course, it would be foolish to predict, but if it occurs at all, it would seem likely to occur between, say 1913 and 1916. This prognostication is, of course, purely tentative and based chiefly on the existence of the expansive tendency shown in the diagram and the fact that such a tendency led to the crisis of 1907 and, so far as our fragmentary knowledge allows us to judge, to the crises of 1857, 1866 and 1873.⁸ The incubating period for such a crisis varies in different cases, but seems to be shorter when prices are rapidly rising than in other cases. The chief factor at work during the incubating period is, so far as the world in general is concerned, the increase in the supply of gold; and so far as conditions in this country in particular are concerned, it is the unprecedented extension of deposit banking.

The disproportionate growth of deposit banking and the consequent increase of the purchasing ability of the population is strikingly shown by the decreasing percentage which cash transactions ($M'V'$) bear to the total of all transactions, $MV + M'V'$, and the increasing percentage which the check transactions ($M'V'$) bear to the same total.

The calculations given above enable us to determine with considerable precision the relative importance of cash and check transactions during the fifteen years under consideration. They are as follows:

(1)	(2)	(3)	(4)
	$\frac{M'}{M}$	$\frac{MV}{MV+M'V'}$	$\frac{M'V'}{MV+M'V'}$
		Per cent	Per cent
1896.....	3.1	14	86
1897.....	3.2	14	86
1898.....	3.3	13	87
1899.....	3.8	12	88

⁸ This statement is in accordance with the facts and theories in Juglar's *Des Crises Commerciales*, Paris (Guillaumin), 1889; Thom's *Brief History of Panics in the U. S.*, New York (Putnam), 1893; Babson's *Business Barometers for Forecasting Conditions*, 1910, Wellesley Hills; and my *Purchasing Power of Money*.

1900.....	3.6	12	88
1901.....	4.2	11	89
1902.....	4.3	11	89
1903.....	4.1	11	89
1904.....	4.2	11	89
1905.....	4.5	10	90
1906.....	4.3	10	90
1907.....	4.4	10	90
1908.....	4.0	10	90
1909.....	4.1	9	91
1910.....	4.4	8	92

Here we notice, in column 2, that the ratio between bank deposits subject to check and money in circulation $\left[\frac{M'}{M}\right]$ has increased from

3.1 to 4.4; and that the percentage of cash transactions, $\frac{MV}{MV+M'V}$, has declined from 14 per cent to 8 per cent while the percentage of check transactions has increased from 86 to 92 per cent.

Though we in America are accustomed to take pride in the fact that we use checks more than any other nation, this tendency may well give us pause. So extensive a use of checks must certainly tend to aggravate those periodic collapses in credit which follow a crisis.

But, while the instability of our purchasing power is aggravated by credit fluctuations, these fluctuations are usually initiated by alterations in the supply of our basic metal, gold. We cannot continue fanatically to defend gold as the best standard when it produces such violent and opposite fluctuations as we have witnessed—fluctuations first in the great rise of prices between 1850 and 1857, second in the great fall between 1873 and 1896, and third, in the great rise between 1896 and 1910. In fact the moral of the figures we have obtained seems to be that economists should turn their thoughts seriously to the question of controlling the purchasing power of money. I have attempted in *The Purchasing Power of Money* to discuss various plans for this purpose including a new and, I believe, safe and practicable proposal.

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